NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

SURFACE DRAINAGE, MAIN OR LATERAL

(feet)
CODE 608

DEFINITION

An open drainage ditch constructed to a designed size and grade.

PURPOSE

To dispose of excess surface or subsurface water, intercept groundwater, control groundwater levels, provide for leaching of saline or alkali soils, or a combination of these objectives.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where the following conditions exist:

1. All lands to be drained shall be suitable for agriculture after installation of required drainage and other conservation practices.
2. In areas where an outlet for the drainage system will be available, either by gravity flow or by pumping. The outlet shall provide for the quantity and quality of water to be disposed of. Consideration shall also be given to possible induced flood damages above or below the point of discharge that might involve legal actions.

Scope

This standard applies to ditches for disposal of surface and subsurface drainage water primarily collected by drainage field ditches and subsurface drains.

It provides minimum drainage requirements for multiple-purpose channels that provide drainage outlets for agricultural lands. Mains or laterals having a drainage area of more than one square mile must meet the stability and maintenance requirements of the standard for **Open Channel** (582). The practice **Surface Drainage, Field Ditch** (607) for the disposal of surface water is not applicable.

CRITERIA

The design and installation shall be based on adequate surveys and investigations.

Drainage requirements. Mains and laterals shall be located and designed to serve as integral parts of a surface or subsurface drainage system that meets the conservation and land use needs. The degree of drainage required by the crops shall be determined and expressed in terms of drainage coefficients or depth and spacing of drains.

Capacity. The ditch capacity shall be adequate to provide for the removal of excess water, based on climatic soil conditions and the needs of crops. The required capacity shall be obtained by determining the watershed area; the required topographic, soil, and land use information; and use of the appropriate drainage coefficient curves.

The required capacity of open ditches for subsurface drainage in irrigated areas shall be determined by evaluating site conditions, including irrigation water deliveries, irrigation canal or ditch losses, soil stratification and permeability, deep percolation losses, water table, field

irrigation losses, and quantity of surface water to be carried by the drainage ditch.

Hydraulic grade line. The hydraulic grade line for drainage ditch design shall be determined from control points, including elevations of significant low areas served by the ditch and hydraulic grade lines of any tributary ditches and the outlet. If control point elevations are estimated rather than computed from survey data, the hydraulic grade line shall be no less than:

1. One foot below fields which will receive normal drainage from ditches draining more than one square mile.
2. 0.5 foot for ditches draining 40 to 640 acres.
3. 0.3 foot for ditches draining less than 40 acres.

For lands to be used only for the more water-tolerant crops such as trees and grasses, these requirements may be modified and the hydraulic grade line set at ground level. These provisions do not apply to channels where flow is contained by dikes.

The effects of hydraulic losses caused by culverts, bridges, or other obstructions in the channel section shall be considered.

Depth. Drainage ditches shall be designed deep enough to allow for normal siltation. If needed, the design depth and capacity may be increased to provide adequate subsurface drainage or for normal flow. The increase shall be based on an evaluation of site conditions. Ditches that serve as outlets for subsurface drains shall be designed for a normal water surface at or below the invert of the outlet end of the drain. The clearance between a drain invert and the ditch bottom shall be at least one foot for ditches that fill with sediment at a normal rate, except where lower values are specified for a job because of unusual site conditions. The normal water surface is the elevation of the usual low flow during the growing season.

Cross section. The design ditch cross section shall be set below the design hydraulic grade line and shall meet the combined requirements of capacity, limiting velocity, depth, side slopes, bottom width, and if needed, allowances for initial sedimentation. Side slopes shall be stable, meet maintenance requirements, and be designed based on site conditions.

Velocity. The maximum permissible design velocity shall be nonerosive for the soil and planned treatment. The following table shall be used to determine maximum permissible channel velocities:

Soil Erosion Resistance Group1/	Maximum Velocity (fps)
I	5.5
II	4.5
III	3.5
IV	2.5

1/ Soil erosion resistance groups for all Hawaii soils can be found in the EFM, Chapter 2.

A desirable minimum velocity is 1.5 feet per second. On flat grades a channel cross section shall be selected, based on depth and maintenance requirements which will result in the desirable minimum velocity if possible.

The velocity for newly constructed channels with drainage areas in excess of one square mile shall meet the stability requirements specified for open channels (582).

Capacity design. Manning Formula shall be used for determining the design velocity and the value of "n" shall be based on alignment, probable vegetative growth expected with normal maintenance, other roughness factors, and the hydraulic radius.

Unless special site studies are available to justify other values, the following values of "n", based on the hydraulic radius of the channel and assuming an aged channel with good maintenance and good alignment, shall be used in solving the Manning Formula for mains and laterals when determining the design for required capacity.

Hydraulic Radius	"n"
Less than 2.5	0.040 - 0.045
2.5 to 4.0	.035 - .040
4.1 to 5.0	.030 - .035
More than 5.0	.025 - .030

Berms and spoil banks. Adequate berms shall be provided and shaped, as required, to provide access for maintenance equipment, to eliminate the need for moving spoil banks in future operations, to provide for work areas and facilitate spoil-bank spreading, to prevent excavated material from washing or rolling back into ditches, and to lessen sloughing of ditch banks caused by heavy loads too near the edge of the ditch banks. The following minimum berm widths shall be provided:

Ditch Depths (Ft.)	Minimum Berm Width (Ft.)
2-6	8
6-8	10
Over 8	15

If spoil material is to be placed in banks along the ditch rather than spread over adjacent fields, the spoil banks shall have stable side slopes. Provision must be made to channel water through the spoil and into the ditch without causing serious erosion.

PLANNING CONSIDERATIONS FOR WATER QUANTITY OR QUALITY

Water Quantity

1. Effects on the water budget components, especially with regard to effects on runoff, soil water, and water tables.
2. Potential changes in soil moisture that will affect the growth of desirable vegetation.
3. Effect on ground water recharge.

Water Quality

1. Effects on the detachment and transport of sediment and chemicals and dissolved and sediment-attached substances into watercourses.
2. Effects on the salinity of drained soils an downstream watercourses.
3. Effects on wetlands.
4. Effect on the quality of groundwater.
5. Potential for changes in downstream water temperature,
6. Effects on downstream visual quality.

OPERATION AND MAINTENANCE

Requirements for operating and maintaining all drainage mains and laterals having drainage areas in excess of one square mile shall be according to the standard for the practice **Open Channel** (582).

Travelways for maintenance. All drainage mains and laterals with drainage areas in excess of one square mile shall be provided with travelways for maintenance as specified in the standard for **Open Channel** (582).

Related structures and ditch protection. Mains and laterals shall be protected against erosion by chutes, drop structures, pipe drops, other suitable structures or grassed waterway, or specially graded channel entrances where surface water or shallow ditches enter deeper ditches.

Grade control structures, bank protection, or other suitable measures shall be used if

necessary to reduce velocities and control erosion.

Culverts and bridges shall have enough hydraulic capacity and depth for drainage needs and to minimize obstruction to flow.

Capacities of pipe or drop structures ordinarily shall be determined by use of the applicable drainage coefficients with the "island-type" of construction used to protect the structure from washout.

Each structure for an open ditch system shall be designed according to Natural Resource Conservation Service standards for the kind of structure and type of construction used.

Channel vegetation. Vegetation shall be established on channel banks, berms, and spoil banks according to the standard for the practice **Critical Area Planting** (342).

CONSTRUCTION PLANS

Plans for the construction of mains or laterals shall be in keeping with this standard and shall describe the requirements for construction of the practice to achieve its intended purpose.

Construction plans should include the location and alignment of each channel; cross section (depth, bottom width, and side slopes); length and grade. Spoil disposal areas and areas requiring vegetation shall be identified, and the recommended species, planting method, and fertilizer requirements shall be shown on the plans. The plans for a main or lateral may be incorporated into an engineering plan for a drainage system which contains other practices and related structures.